# Virtual Reality Museum

A project in the course Interaction Design (MAMN25)
Department of Design Sciences, Lund University


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Try me out!

Click on the painting!

# Summary

# 1. Introduction

## 1.1 Background

Visiting a museum is a good way to learn not only about history, but also about artists and their masterpieces. The nature and range of the educational role of museums have changed and grown dramatically in recent years. In grasping the complexity of the educational role of the museum, three words reoccur: education, interpretation and communication [1].

Nowadays, many people regard visiting a museum as a way to relax and studies reveal that even during the pandemic in 2020 the number of people visiting them stayed quite high. It is very interesting to notice how different continents have different preferences: between 2019-2021, in Europe, art museums were the most visited while in the Asian-Pacific area science and technology museums were preferred [2]. According to older statistics from 2015, it came out that the European age groups from 16-24 and 25-34 were the ones that visited at least one museum that year and, more in general, citizens from northern countries visited more cultural sites than their counterparts in the southern part of the continent [3].

## 1.2 Purpose

Our aim was to create a project that combines VR techniques with Interaction Design principles to come up with a Virtual Reality Museum, which could provide a unique, interactive and educational experience for different kinds of visitors. Indeed, even according to the previously seen statistics, there might be people whose working hours clash with museums' opening hours and, therefore, can't visit them. Or, even, there are many people who are interested in new technologies and like to try new things: this can be a good chance for them to explore VR; the same is, of course, especially true for art lovers.

To design a user-friendly, easy-to-navigate VR environment that allows audiences to authentically explore the museum. Some key aspects of the project are interactivity and accessibility. We aim to ensure it will be friendly to users in different situations and make it more interactive.

## 1.3 Interaction design process

To find out what people are most interested in when visiting museums and what expectations they might have, we firstly made a user research plan, creating a questionnaire and, subsequently, interviewing some of the potential users. After gathering all the data, we used thematic analysis to classify our qualitative data and sorted the needs into three different parts (necessary, desirable, unnecessary). Next step was to generate ideas from the results and think of some realistic scenarios. Using them as a reference, we developed the different versions of our prototype and tested them with our colleagues, receiving feedback on how to improve our project.

# 2. User Research

The first step in the development of our project was to research the (potential) users' needs and what they might expect from the museum. In order to do so, we created an online questionnaire to reach as many people as possible and to gather feedback from people that have different backgrounds [4].

Our first point was to understand whether there is a consistent number of people interested in visiting museums or if the majority of them just regards this as a "boring" activity. Luckily, we had a positive outcome so we were able to actually analyze the data we got and get some relevant information out of it.

## 2.1 Questionnaire

The questionnaire, as already said, was our first step and the questions we asked can be divided into:

- General questions about the users' habits regarding their visits to museums
  - Aim: to understand whether people would be interested in trying out such a product;
- Questions about past experiences with Virtual Reality Museums or any kind of more technologically advanced museums, if any
  - Aim: to understand the kind of approach to be put into developing each functionality and to have insight into their expectations;
- Questions about functionalities they would like in the project (e.g, selecting music, changing the environment…)
  - Aim: to get proper feedback about fun additions we thought about.

We gathered more than 100 submissions with the main age group being 19-25. The data reveals that most people do enjoy going to museums, especially when in company, and there is also a relevant group of people that is used to travel long distances to visit special exhibitions.

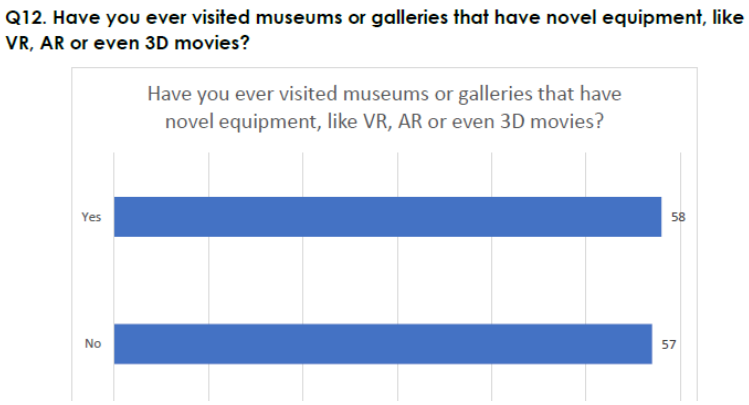



*Figure 1: Questionnaire, past VR/AR experiences*

As we can see in this graph, about ½ of the participants did have VR or AR experiences in a museum but quite a few of them did not manage to enjoy their time, given some circumstances such as queues and short time to explore around.

We also received positive feedback about the aforementioned additions. Another thing we intended to explore with this questionnaire was the possibility of implementing functions to help users with limited mobility but, unfortunately, we did not gather enough inputs to properly think about likely solutions.

**Q7. Which painting styles do you prefer?**

(In this question, participants were allowed to express more than one preference)

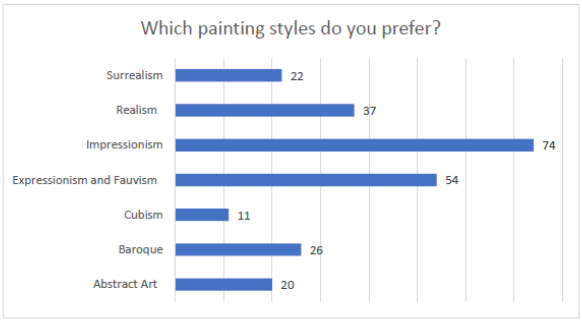



*Figure 2: Questionnaire, preferred painting styles*

Since people expressed preferences for multiple styles, we decided to divide the museum into multiple areas to let them enjoy different artistic representations.

## 2.2 Interviews

We then conducted some interviews with people that participated in the questionnaire, taking into account whether they had already experimented with VR equipment or if they hadn't. For people who had, the questions focused on their past experiences and especially what they enjoyed or what they found difficult; for the other category, it was more about their expectations. The interviewees' answers reflected the same thoughts: the main point everyone agreed on was the necessity of having instructions about how to move around in the museum and how to interact with the paintings; also, the aspect they were the most excited about was the possibility to actually get into the painting's world.

## 2.3 Affinity-Diagramming board

Given the data we got from the previous steps, to exactly pinpoint the features we wanted in our final product, we created an Affinity-Diagramming Board [5]. By printing all the answers we received and by dividing them into themes, we managed to highlight the most important parts and organized them into different categories, as it is possible to see in the following table.

What we can gather from this is that people would enjoy visiting the virtual version of a museum, that has pretty much the same characteristics but, as a plus, the possibility of "Walking inside the painting".

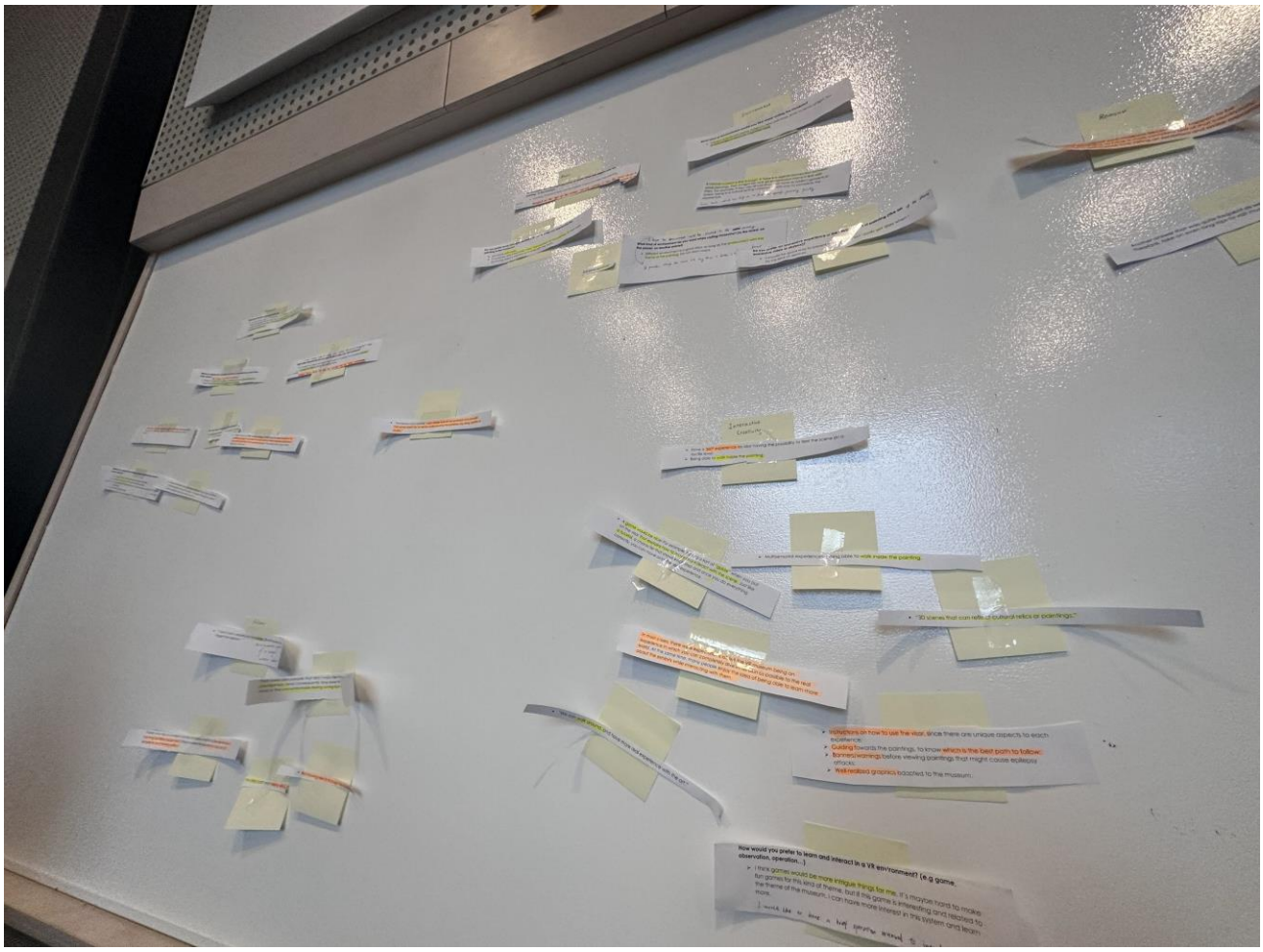


*Figure 3: Thematic Analysis. Affinity Diagramming Board*

| Necessary | Desirable | Unnecessary |
|---|---|---|
| **INFORMATION** | | |
| Main characteristics of the painting | Author | |
| Historical setting | Painting techniques | |
| **AMBIENCE** | | |
| Music related to the painting | Soft, background music | |
| Gallery (mainly) in an enclosed space | Alternative environment related to the painting | |
| **INTERACTIVE EXPERIENCE** | | |
| Walking inside the painting | Having audio and subtitles as alternatives | Experience akin to the real world |
| | Multiplayer mode | |
| | Provide a small game to help with getting the hang of the museum. | |

# 3. Design Concept

The following step was to think about how the actual museum would look like, how users could interact with the paintings to know more about them and so on.

From the get-go we already had a general idea of what we wanted to realize, having been inspired by our previous experiences. Even so, each of us spent some time working on some low-fidelity prototypes, and we realized both storyboards and sketches, later combining them into two short videos representing 2 different scenarios [6], to which we added a 3rd one.

## 3.1 Scenario 1

In the first scenario, we have a young Swedish man, Hans, who is checking some flight tickets to France to take a break from studying. He would like to go to Paris to visit some museums but the cost of the tickets is way out of his budget. As a much cheaper alternative, he decides to try out a new app everyone is talking about: VR Museum. He puts on his visor, grabs the joysticks and starts the game. Once he is in, he wonders "How do I walk around? How can I interact with the paintings?".

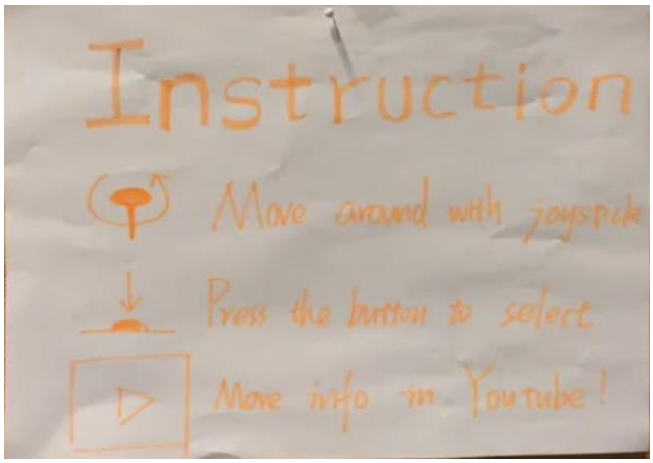



*Figure 4: Scenario 1. Instructions*

Luckily, he notices quite soon that there is an Instructions board he can read and, therefore, he is able to move on.

While walking around, he notices a painting he can recognize and gets closer to it.

*Figure 5: Scenario 1. Example painting*

There are 3 buttons next to it and, after he presses the first one, music starts playing; after that, he presses the second one and manages to view information about the painting. In the end, he presses the third one and actually goes into the drawing.

Once he is happy enough with this first experience, he checks the navigation map and moves onto the next painting.

## 3.2 Scenario 2

Mark and Erik are two friends who haven't seen each other in a while and so Erik suggests to Mark to try out this interactive virtual museum where they can also meet up and chat. After Erik invites Mark inside his space, they can see each other and the former goes on to show Mark the most interesting features in the museum. Since they are together, they can also play a fun game: each of them will be able to paint they are standing in front of and the algorithm of the game will be able to say who managed to do the best imitation! Mark ends up winning and, after congratulating him, the two friends continue to walk around in the museum.


*Figure 6: Scenario 2*

## 3.3 Scenario 3

Patricia is a middle school Arts teacher who would love to bring her students to a museum to help them have a better understanding of some paintings they have been studying. But they live in a small town and there's no museum nearby, so she starts looking for some alternatives. While checking some arts forums, she gets notice of a new game named VR Museum, which allows its users to visit a virtual museum with real paintings and, luckily, it also has multiplayer mode! So she talks about this idea to her students and they all react in a very enthusiastic way. The following day, they all "set foot" in the museum and, even though, it's a bit hard to manage all the kids, everyone ends up having a great time, especially when entering the paintings: even those students who usually don't pay attention to her classes ask her lots of questions! Patricia and her class are now really looking forward to the future updates of VR Museum.

# 4. User Interface Design

As a result of the scenarios we just saw, we managed to create this Interaction Flow diagram that we used as a basis of our first prototype. The only change we made in the version we later presented in the first user testing was the possibility of changing the game mode and to check the instructions even later in time, not only at the beginning.

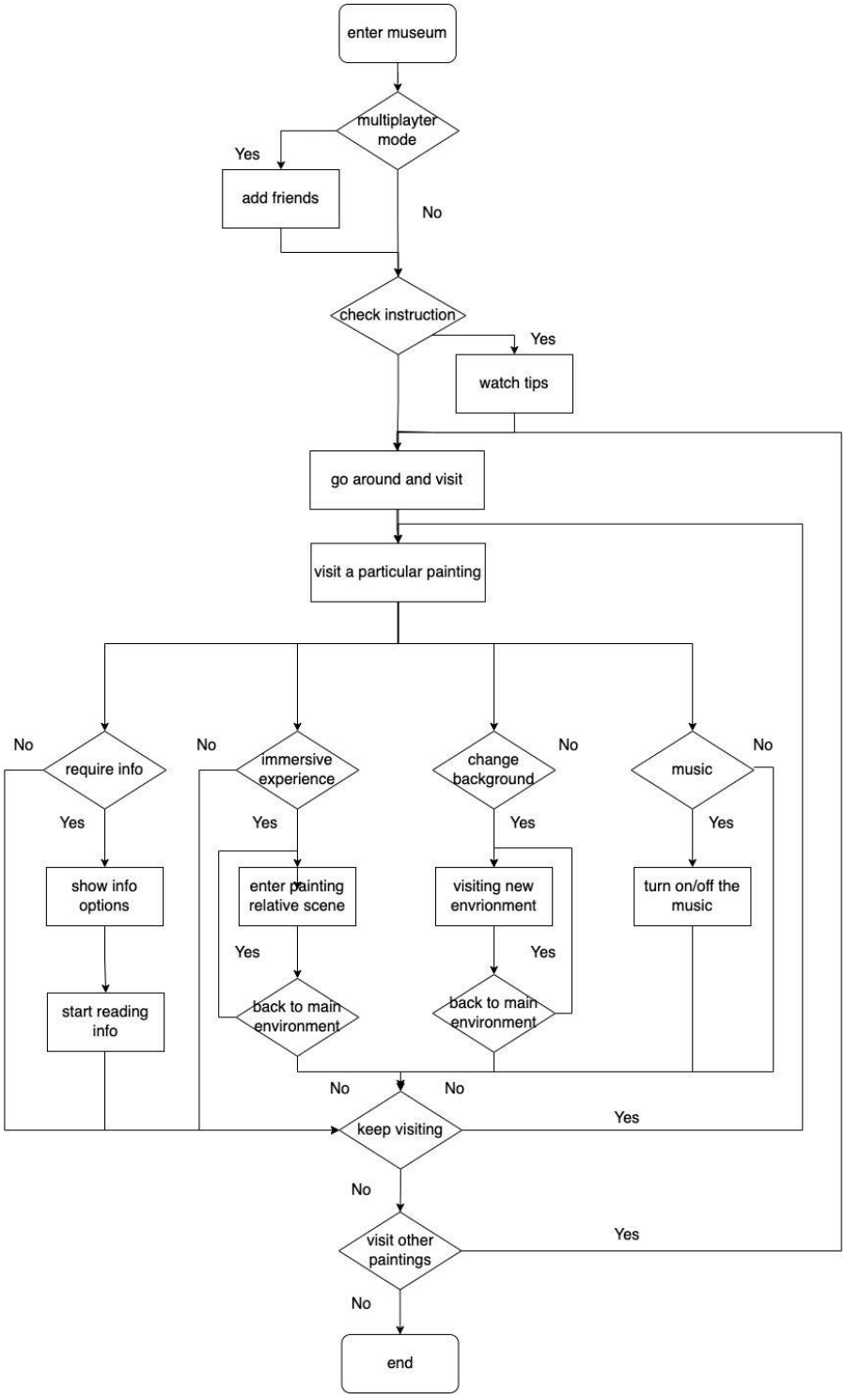
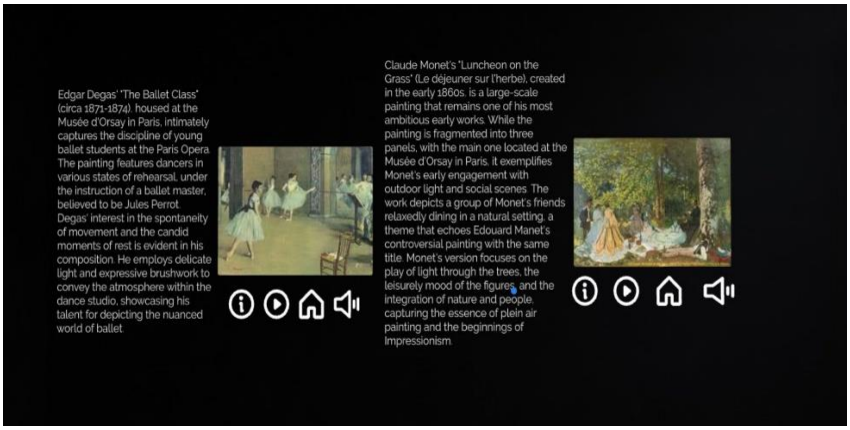



*Figure 7: Interaction Flow Diagram*

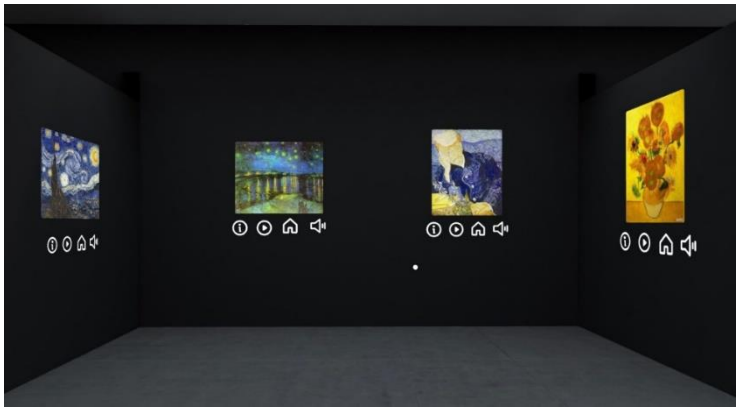
To realize our actual prototypes, we made sure to keep in mind *Nielsen's 10 Heuristics* [7]. We made sure to have a minimalistic design (#8) with icons whose meaning could easily be understood (#2) and tried to keep the possible mistakes that could be made to a minimum (#5), as much as the interface allowed us. For all those parts we couldn't improve, we made sure to provide additional information nearby (#6).

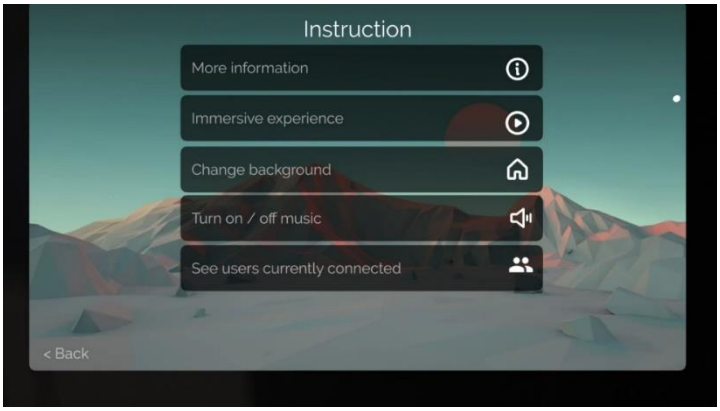
## 4.1 1st HI-FI Prototype




We opted for a palette of colors that includes white, gray, light brown and black.

*Figure 8: HI-FI prototype. First version*






To realize our prototypes we used the platform *WondaVR* which allows its users to create spaces that can be accessed in Virtual Reality.

In this initial phase, we created a small museum by adding some pictures and the buttons to interact with them.

- The 1st button displays information about the painting;
- the 2nd is the supposed to let the users have the immersive experience; since this function is not implemented yet, it instead plays a video of the painting to sort of recreate the idea;
- compared to the example we made in our scenarios, we added a new button that allows the users to change the environment they are in (feature that we had previously detected in the user research);
- the 4th button is to play some music that recalls the atmosphere of the painting.

Some features related to the multiplayer mode weren't initially (or completely) implemented to just concentrate on the single-player mode, which can be defined as the standard way to explore the museum.

At this point, we had our first User evaluation with our colleagues and in the Evaluation section (5.1) you will be able to read more about it and the reasons behind why we changed some things in the final version. Following these exchanges, we made some changes to realize our final HI-FI prototype.

## 4.2 Final Prototype

LINK: https://wvr.li/ybf9q1 (single player mode, no registration required)

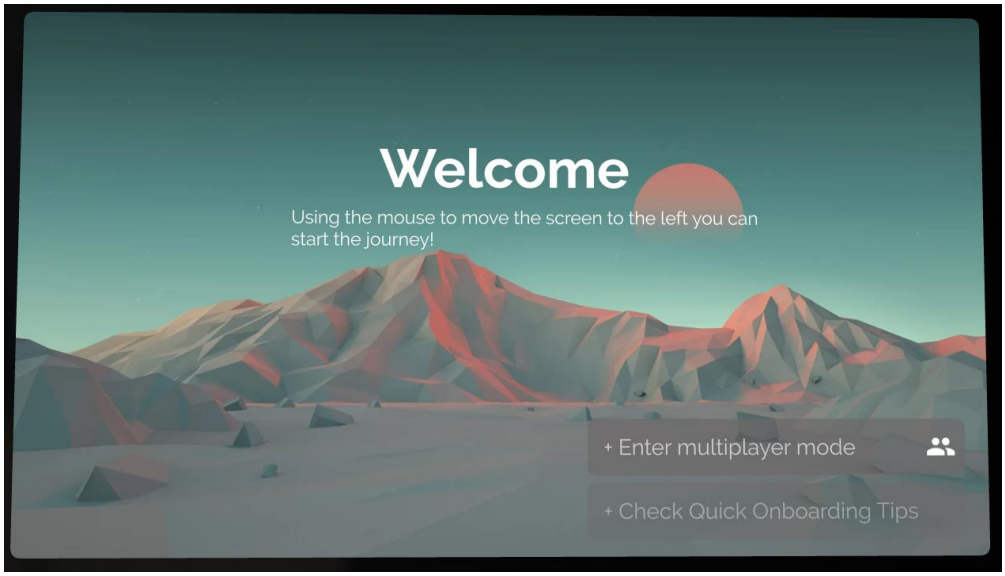



*Figure 9: HI-FI prototype. Final version, Homeboard*

The first thing users will see when logging into the museum is this welcome board that allows them to choose whether they want to invite some friends and enjoy their time together but they will also be able to check the previously seen tips.

This is what the final version looks like:

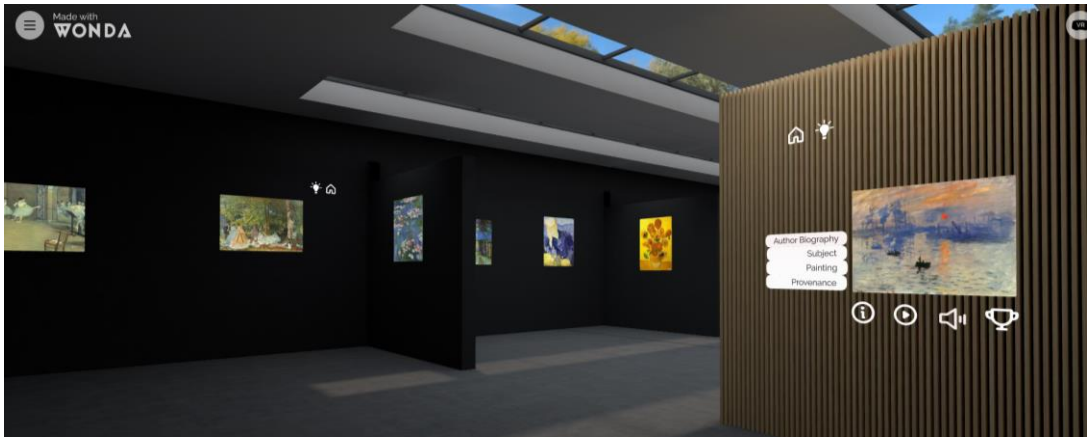



*Figure 10: HI-FI prototype. Final version, general view*

First of all, the information is organized into some categories to avoid displaying big text boxes; the "Home" button (to change the environment) was moved on the wall, rather than under each painting and, instead, a new button was added. The "Prize" button is actually something that we had already talked about: it is indeed the painting game to be played between 2 users, as shown in the 2nd scenario. We also added the "Lightbulb" button to quickly remind the users what each button is used for.


Lastly, this is what users see if they choose to switch the environment they are staying in.

*Figure 11: HI-FI prototype. Final version, alternative environment*

# 5. Evaluation

Since we wanted to find how to improve the user experience, we did a Qualitative Usability Testing [8] to have insights about how people use the service.

## 5.1 Evaluation after Users Testing 1

From our 1st evaluation a couple of issues emerged that we needed to solve, mainly linked to the confusion created by the buttons:

- The music button in particular caused some problems since, if the user were to press more than one music button, the songs would end up overlapping and there was no way to know which were the "guilty" paintings;
- the Home button as well was criticized because, since it was under each painting, users expected that the environments would end up being different; instead, it was always the same.

Since the platform we used had some limits, we had to find some roundabout ways to deal with these problems. In the case of the music button, since there was no way to change the color of the buttons or to stop one song if another started playing, we decided to display a small text as an indication that there was some music playing from that place.

As for the second issue, we removed the Home buttons from under the paintings and, instead, moved them to the wall they were put on (one button per wall). In this way, it would have been clear that it had a more general scope. In addition,

to clear up any misunderstandings users might have, we added another button to quickly remind them about the function of each of the buttons under the paintings.

## 5.2 Evaluation after Users Testing 2 – Test plan and Results

During our final class, we had the possibility to have users test our final version, corrected with the previous observations. The scenario was the user being at the entrance of the VR museum and going to explore the different kinds of paintings. Users have the options to use both the multiplayer mode and single-player mode, along with a variety of interaction functions. We just let the user experience the museum freely and had them comment aloud while they navigated through the virtual environment. The key points we focused on are:

- Do users feel confused when interacting with the painting?
- Do users feel uncomfortable with the display of our museum's painting collection?
- Do users find certain features to be unreasonable?
- Other comments about our prototype?

Having more buttons explaining details about the functions certainly helped to improve the experience but, unfortunately, we had some issues when trying out the multiplayer feature.

Indeed, while players managed to actually talk to each other (using the voice channel or the chat function) and even try out the game, the website ended up not being able to properly work with multiple people connected and some buttons stopped working in that mode. So, we had to give up continuing testing the multiplayer function and concentrate on the single player scenario.

We also received positive feedback especially regarding the changes made to the alternative environment feature.

To gather comprehensive feedback on our prototype, we also designed a simple questionnaire (based on the UEQ available online) to complete after testing, to capture their experience interacting with the application. This is what came out:

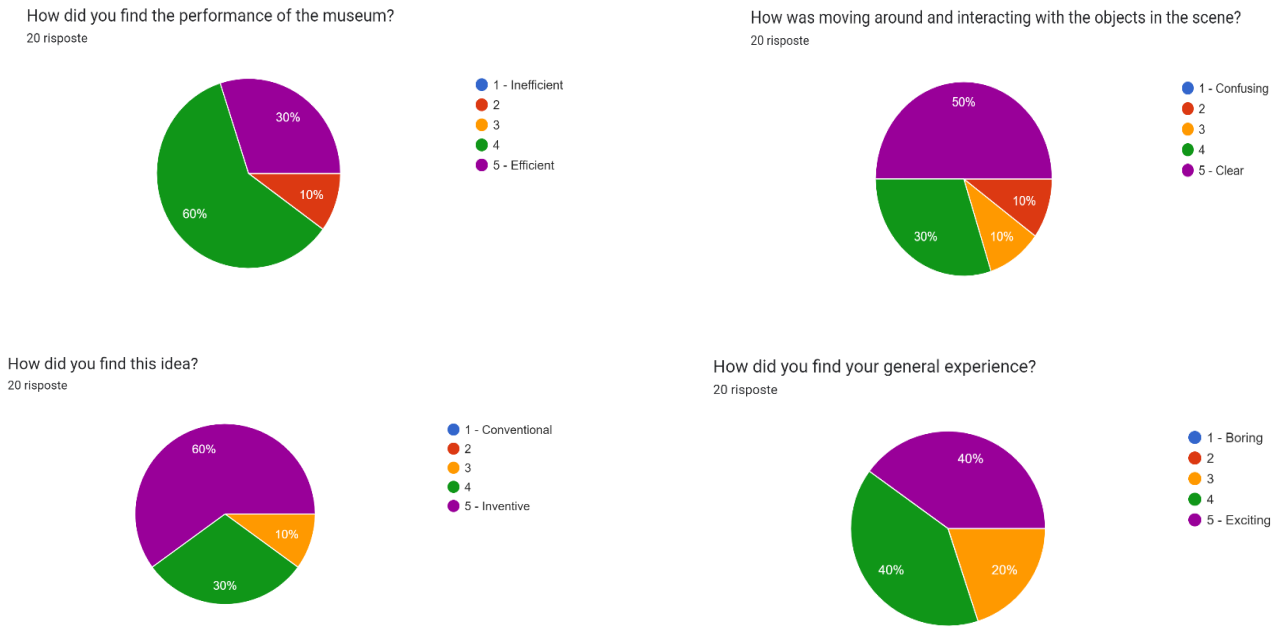



*Figure 12: Results from the final Evaluation questionnaire*

In general, these are pretty good results and, as we can see, the lowest scores are from the performance/moving around: this doesn't come as a surprise given what we just explained. After this testing, we implemented some small changes to better point out which immersive experiences were already implemented and what instead were not.

# 6. Discussion

If we were to compare the feedbacks we got from the 1st and 2nd user testing, the changes we made to the prototype definitely helped improve the user experience.

One important thing to keep in mind is that it was all tested without actually using visors but just the laptops and the moving around was done by using some keypads and the mouse. For sure, this was not the optimal approach but given the impossibility of testing with the visors, we are more than satisfied with the results.

The platform we worked on was online so some lagging was unfortunately unavoidable and this also ended up affecting negatively the user experience. In the final actual product, this is an issue we would need to work on only when in a multiplayer mode since it requires an online connection; in the single-player mode, everything would be offline.

As aforementioned, adding more buttons around the scene to help the users understand the functionalities they have access to also proved to be helpful.

To sum up, had we had more time to work on the project and actually realize the application writing the code, many of the problems we encountered could have probably been avoided. The first thing we would have done would have been adding proper feedback to the users' actions (e.g., icons changing color when clicked on) and also add button descriptions whenever the user focused on one.

We ended up confirming that people who are more interested in art spent more time looking around and trying out the features while others just walked around more quickly, effectively recreating the same behaviors from when one would visit a museum in real life.

Undoubtedly, even making these small changes, would be greatly improve the performance. Overall, users enjoyed the experience and were satisfied with it. Regarding our team, we are happy with our work and we learnt many things that we'll be able to use not only on similar projects but also in other that require group work.

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